

THE INCIDENCE OF DERMATOPHYTES, KERATINOPHILIC AND SAPROPHYTIC FUNGI IN PLAYGROUND OF SCHOOLS AND HOUSE DUST IN UPPER EGYPT

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ABSTRACT - 50 dust samples collected from school playgrounds and houses from Upper Egypt (Assiut and Sohag Governorates) were examined for the presence of dermatophytes, keratinophilic and saprophytic fungi using sterile human-hair fragments as baits at 25°C. 33 species and 2 varieties belonging to 17 genera were collected. A large number of these fungi were either well-known agents of human and animal mycosis or have been frequently encountered from human and animal lesions. Dermatophytes were represented by 3 species: *Microsporium gypsum*, *Trichophyton mentagrophytes* and *T. terrestre*. Keratinophilic fungi closely related to dermatophytes are represented by *Arthroderma cuniculi*, *Chrysosporium asperatum*, *C. lobatum*, *C. indicum*, *C. keratinophilum*, *C. pannicola* and *C. tropicum*. Other saprobic moulds were also collected: *Acremonium* (2 species), *Alternaria* (1 species), *Aspergillus* (5 species + 1 var.), *Chaetomium* (2 species), *Fusarium* (3 species), *Penicillium* (3 species), *Scopulariopsis* (1 species) and several others. These fungi varied in their presence in the two environments and several species are well-known mycotoxin-producing fungi.

RÉSUMÉ - Une recherche de champignons dermatophytes, kératinophiles et saprophytes a été effectuée dans des poussières de terrains de jeux et de maisons (50 échantillons), en Haute Égypte. Pour cela, des fragments de cheveux ont été utilisés comme pièges. 33 espèces et 2 variétés appartenant à 17 genres ont été recensées. Nombre d'entre eux sont connus comme agents de mycoses humaines et animales ou pour avoir été isolés de lésions. Les dermatophytes sont représentés par 3 espèces: *Microsporium gypsum*, *Trichophyton mentagrophytes* et *T. terrestre*, les kératinophiles sont: *Arthroderma cuniculi*, *Chrysosporium asperatum*, *C. lobatum*, *C. indicum*, *C. keratinophilum*, *C. pannicola* et *C. tropicum*. D'autres moisissures saprophytes ont été isolées: *Acremonium* (2 esp.), *Alternaria* (1 esp.), *Aspergillus* (5 esp. et 1 var.), *Fusarium* (3 esp.), *Penicillium* (3 esp.), *Scopulariopsis* (1 esp.) et plusieurs autres. Ces champignons varient suivant le substrat où ils ont été isolés et plusieurs espèces sont potentiellement productrices de mycotoxines.

KEY WORDS : dermatophytes, keratinophilic fungi, saprophytic fungi, Egypt.

INTRODUCTION

The occurrence and distribution of dermatophytes and other keratinophilic fungi in soils and other substrates have been studied in many parts of the world by numerous researchers (Al-Doory, 1967; Alteras & Evolceanu, 1969; Ajello & Padhye, 1974; Caretta et al., 1977; Bojanovsky et al., 1979; Abdel-Fattah et al., 1982; Ali-Shtayeh & Asa'd Al-Sheik, 1988; Abedl-Hafez et al., 1989 a, b; Youssef et al., 1989; Karm El-Din et al., 1990). These fungi have been recognized as causal agents of human and animal diseases (Franger & Belsan, 1975; Frey et al., 1979; Rippon, 1982; Frelier et al., 1985; Mitchell et al., 1987). The present work has been carried out to study the incidence of these fungi in playground of schools and house dust in Upper Egypt.

MATERIALS AND METHODS

Fifty dust samples were collected from playground of various schools (elementary and preparatory) and from houses (25 samples from each environment) at Assiut and Sohag Governorates (Upper Egypt). Each dust sample was put in a clean polyethylene bag, transferred to Mycological laboratory and stored at 2°-5°C till fungal analysis.

The dust samples were analysed chemically for the estimation of organic matter and total soluble salts contents (Jackson, 1958). A pH-meter was used for estimation of dust pH. The electrode was immersed in the dust suspension with a ratio of 1:5 (w/v).

Isolation of keratinophilic fungi:

The air baiting technique was employed as recommended by Vanbreuseghem (1952). 50g of dust were put in a sterile plate and 5 plates were used for each sample. A sufficient quantity of sterile distilled water was added to rise the moisture content of dust to about 25-30% and mixed thoroughly. Sterile human-hair fragments were scattered on the dust surfaces. Plates were incubated at 25°C for 12-14 weeks. Five bait fragments (from each) plate were transferred to the surface of Sabouraud's glucose agar medium (Moss & Mc Quown, 1969) supplemented with chloramphenicol (0.05 mg/ml) and actidione (0.5 mg/ml). Plates were incubated at 25°C for 3-4 weeks and the developing fungi were counted, identified (based on macro- and microscopic characteristic) and the numbers were calculated per 25 hair fragments for each sample. The relative importance value (RIV) was calculated for each fungal genera and species (Ali-Shtayeh & Asa'd Al-Sheikh, 1988).

The following references were mainly used for the identification of fungi: Carmichael (1962), Raper & Fennell (1965), Booth (1971), Ellis (1971), Frey et al. (1979), Domsch et al. (1980), Van Oorschot (1980) and Ramirez (1982).

RESULTS AND DISCUSSION

The amount of organic matter and total soluble salts in dust samples were very low and fluctuated between 0.5-1.1% and 0.3-0.8%, respectively. The pH values of playground and house dust samples were alkaline and ranged between 7.1-7.8. The total numbers of isolates of dermatophytes and other keratinophilic and saprophytic fungi in playground of schools and house dust varied between 3-11 and 2-9 colonies/25 hair fragments, respectively (Table 1). Results show that there was no correlation between the total number of isolates in each sample and number of genera and species, but in several samples the high number of isolates coincided with high numbers of genera and species and vice versa. This agrees the results obtained by Abdel-Hafez & Shoreit (1985) and Abdel-Hafez et al. (1986).

Table 1. - Total isolates (TC: calculated per 25 hair fragments) and number of genera (NG) and species (NS) recorded in play-ground and house dust particles baited with human hair at 25°C.

Tableau 1. - Nombre total d'isolats (TC), de genres (NG) et d'espèces (NS) isolés de poussière de terrains de jeux et de poussières domestiques, piégés avec des cheveux humains (25 fragments) à 25°C.

Sample number	Schoolplayground			House dust		
	TC	NG	NS	TC	NG	NS
1	6	2	2	5	2	3
2	4	1	1	3	1	2
3	7	3	3	8	3	4
4	9	4	5	6	2	2
5	3	1	1	7	3	?
6	7	3	3	5	2	2
7	10	4	6	3	1	1
8	5	1	2	5	2	2
9	8	3	4	6	2	3
10	7	2	2	8	4	4
11	8	3	3	6	3	3
12	9	4	4	4	1	2
13	6	2	3	7	3	3
14	8	3	4	5	2	2
15	9	4	4	6	3	3
16	11	5	6	4	2	2
17	6	1	2	3	1	1
18	7	2	3	8	3	4
19	9	3	5	2	1	1
20	8	3	4	5	2	2
21	7	2	2	3	1	1
22	9	4	5	9	4	5
23	7	2	3	4	2	2
24	8	3	4	7	3	3
25	6	2	2	3	1	2

Thirty-three species and 2 varieties belonging to 17 genera were collected from playgrounds (14 genera and 26 species + 2 varieties) and house dust particles (10 genera and 18 species + 1 variety) using human hair fragments as baits at 25°C (Tables 2, 3, 4). Dermatophytes and related fungi comprised four genera: *Arthroderma*, *Chrysosporium*, *Microsporium* and *Trichophyton*.

Table 2 - Percentage incidence (%I; calculated per 25 samples). Percentage count (%C; calculated per total fungal isolates) and number of species (NS) of various fungal genera recovered from playground and house dust particles baited with human hair at 25°C.

Tableau 2 - Fréquence (% I calculée sur 25 échantillons), pourcentage (% C calculé sur le nombre total d'isolats) et nombre d'espèces (NS) des différents genres.

Genera	Schoolplayground			House dust		
	NS	%I	%C	NS	%I	%C
<i>Acremonium</i> (2)	2	12	2.7	1	16	4.5
<i>Alternaria</i> (1)	1	8	1.1	-	-	-
<i>Arthroderma</i> (1)	1	8	1.6	-	-	-
<i>Aspergillus</i> (5 + 1 variety)	4 + 1	44	20.1	3 + 1	40	25.8
<i>Chaetomium</i> (2)	-	-	-	2	12	3.0
<i>Chrysosporium</i> (6)	6	60	38.6	4	52	40.9
<i>Emericella</i> (1 + 1 variety)	1 + 1	12	1.6	-	-	-
<i>Fusarium</i> (3)	3	24	6.0	1	16	3.8
<i>Geotrichum</i> (1)	-	-	-	1	8	1.5
<i>Microsporium</i> (1)	1	4	1.1	-	-	-
<i>Paecilomyces</i> (1)	1	8	1.6	-	-	-
<i>Penicillium</i> (3)	2	28	7.1	3	20	6.8
<i>Scolecobasidium</i> (1)	1	4	1.1	-	-	-
<i>Scopulariopsis</i> (1)	1	20	4.9	1	16	4.5
Sterile mycelium	-	24	6.0	-	8	3.8
<i>Trichoderma</i> (1)	-	-	-	1	4	0.8
<i>Trichophyton</i> (2)	8	1.6	1	4	0.8	-
<i>Trichothecium</i> (1)	1	8	1.6	-	-	-
Unknown	-	16	3.3	-	12	3.8
Total number of genera = 17	14		100	10		100
Total number of species = 33 + 2 varieties	26 + 2 varieties			18 + 1 variety		

Figures between parenthesis refer to the number of species.

Chrysosporium was the most common keratinophilic genus and was recovered from 60 and 52% of playground and house dust samples comprising 38.6 and 40.9% of total fungal isolates and had the RIV's of 98.6 and 92.9, respectively. It was represented by 6 species of which *C. indicum*, *C. keratinophilum* and *C. tropicum* were the most prevalent in the two environments. They occurred in 24-44% and 16-40% of the samples contributing 8.2-14.7% and 8.3-17.4% of total isolates in the two substrates and possessed the RIV's of 32.2-58.7 and 24.3-57.4, respectively. *C. asperatum* in playground and house dust; and *C. lobatum* and *C. pannicola* in playground samples were less frequent. *C. indicum*, *C. keratinophilum* and *C. tropicum* have world-wide

distribution in soils (Padhye et al., 1967; Alteras & Evolceanu, 1969; Ajello & Padhye, 1974; Piontelli & Caretta, 1974; Marsella & Mercantini, 1986; Ali-Shtayeh & Asa'd Al-Sheikh, 1988). These three species were isolated from Egyptian soils, but with different occurrence (Abdel-Fattah et al., 1982; Abdel-Hafez et al., 1989 a, b; Abdel-Mallek et al., 1989; Youssef et al., 1989; Karam El-Din et al., 1990). Abdel-Hafez et al. (1989a) isolated *C. asperatum* from soils (8% of the samples) of Sinai Governorate (Egypt). It occurred in 4.2% of the floor dust samples of Arab kindergarten schools in the west bank of Jordan (Ali-Shtayeh & Asa'd Al-Sheikh, 1988). *C. pannicola* occurred in 5% of the mud samples of Ibrahimia canal in Egypt (Abdel-Hafez et al., 1989b).

Table 3 - Total counts (TC: calculated per 625 hair fragments), number of cases of isolation (NCI: out of 25 samples) and the relative importance value (RIV) of dermatophytes and closely related fungi recovered from playground and house dust particles baited with human hair at 25°C.

Tableau 3 - Nombre total des espèces de dermatophytes (TC calculé sur 625 fragments de cheveux), nombre de cas d'isolement (NCI sur 25 échantillons) et importance relative (RIV) des espèces.

Genera and species	Schoolplayground			House dust		
	TC	NCI	RIV	TC	NCI	RIV
<i>Arthroderma cuniculi</i> Dawson	3	2	9.6	-	-	-
<i>Chrysosporium</i>	71	15	98.6	58	13	92.9
<i>C. asperatum</i> Carmichael	4	1	6.2	6	3	15.3
<i>C. lobatum</i> Scharapov	2	1	5.1	-	-	-
<i>C. indicum</i> (Randhwa & Sandhu) Garg	15	6	32.2	11	4	24.3
<i>C. keratinophilum</i> (Frey) Carmichael	27	11	58.7	18	7	41.6
<i>C. pannicola</i> (Corda) Van Oorschot & Stalpers	2	2	9.1	-	-	-
<i>C. tropicum</i> Carmichael	21	8	43.4	23	10	57.4
<i>Microsporium gypseum</i> (Bodin) Guiart & Grigorakis	2	1	5.1	-	-	-
<i>Trichophyton</i>	3	2	9.6	1	1	4.8
<i>T. terrestre</i> Durie & Frey	3	2	9.6	-	-	-
<i>T. mentagrophytes</i> (Robin) Blanchard	-	-	-	1	1	4.8
Total isolates	79			59		
Number of genera	4			2		
Number of species	9			5		

Occurrence remarks: High occurrence, between 13-25 cases (out of 25 samples); moderate occurrence, between 7-12 cases; low occurrence, between 4-6 cases; rare occurrence, between 1-3 cases.

Microsporium (1 species) and *Trichophyton* (2 species) were the only dermatophytes isolated in the present study: *M. gypseum* (RIV 5.1) and *T. terrestre* (RIV 9.6) in school playgrounds; and *T. mentagrophytes* (RIV 4.8) in house dust particles. *M. gypseum* has world-wide distribution in soils (Crozier, 1980; Mc Aleer, 1980; Sur & Gosh, 1980; Abdel-Fattah et al., 1982; Ab-

Table 4 - Total count (TC: calculated per 625 hair fragments), number of cases of isolation (NCI: out of 25 samples) and the relative importance value (RIV) of saprophytic fungi recovered from playground and house dust particles baited with human hair at 25°C.

Tableau 4 - Nombre total des espèces de saprophytes (TC calculé sur 625 fragments de cheveux), nombre de cas d'isolement (NCI sur 25 échantillons) et importance relative (RIV) des espèces.

Genera and species	Schoolplayground			House dust		
	TC	NCI	RIV	TC	NCI	RIV
Acremonium	5	3	14.7	6	4	20.5
<i>A. kiliense</i> Gruetz	2	1	5.1	-	-	-
<i>A. strictum</i> W. Gams	3	2	9.6	6	4	20.5
<i>Alternaria alternata</i> (Fr.) Keissler	2	2	9.1	-	-	-
Aspergillus	37	11	64.1	34	10	65.8
<i>A. flavus</i> Link	12	7	34.5	14	6	34.6
<i>A. flavus</i> var. <i>columnaris</i> Link	5	4	18.7	8	3	18.1
<i>A. fumigatus</i> Fresenius	15	8	40.2	10	7	35.6
<i>A. niger</i> Van Tieghem	4	3	14.2	-	-	-
<i>A. terreus</i> Thom	-	-	-	2	1	5.5
<i>A. versicolor</i> (Vuill.) Tirab.	1	1	4.5	-	-	-
Chaetomium	-	-	-	4	3	15.0
<i>C. globosum</i> Kunze ex Fries	-	-	-	3	2	10.3
<i>C. spirale</i> Zopf	-	-	-	1	1	4.8
Emericella	3	3	13.6	-	-	-
<i>E. nidulans</i> (Eidam) Vuill.	2	2	9.1	-	-	-
<i>E. nidulans</i> var. <i>latus</i> Thom & Raper	1	1	4.5	-	-	-
Fusarium	11	6	30.0	5	4	19.8
<i>F. moniliforme</i> Sheldon	2	1	5.1	-	-	-
<i>F. oxysporum</i> Schlecht	3	2	9.6	-	-	-
<i>F. solani</i> (Mart.) Sacc.	6	3	15.3	5	4	19.8
<i>Geotrichum candidum</i> Link	-	-	-	2	2	9.5
<i>Paecilomyces variotii</i> Bainier	3	2	9.6	-	-	-
Penicillium	13	7	35.1	9	5	26.8
<i>P. chrysogenum</i> Thom	8	3	16.3	6	4	20.5
<i>P. funiculosum</i> Thom	9	5	24.9	2	2	9.5
<i>P. variable</i> Sopp	-	-	-	1	1	4.8
<i>Scolecobasidium constrictum</i> Abbott	2	1	5.1	-	-	-
<i>Scopulariopsis brevicaulis</i> (Sacc.) Bainier	9	5	24.9	6	4	20.5
Sterile mycelium	11	6	30.0	5	2	11.8
<i>Trichoderma viride</i> Pers.	-	-	-	1	1	4.8
<i>Trichothecium roseum</i> (Pers.) Link	3	2	9.6	-	-	-
Unknown	6	4	20.5	1	1	4.8
Total isolates	105			73		
Number of genera	10			8		
Number of species	17 + 2 var.			12 + 2 var.		

Occurrence remarks: High occurrence, between 13-25 cases (out of 25 samples); moderate occurrence, between 7-12 cases; low occurrence, between 4-6 cases; rare occurrence, between 1-3 cases.

del-Hafez et al., 1989a, b; Youssef et al., 1989; Karam El-Din et al., 1990) and a causal agent of different types of tinea (Frey et al., 1979). *T. terrestre* was encountered from various substrates, but in different numbers and frequencies, in many parts of the world by several researchers (Jana et al., 1979; Marsella & Mercantini, 1986; Abdel-Hafez, 1989a, b; Youssef et al., 1989; Karam El-Din et al., 1990). *T. mentagrophytes* isolated from soils, man and animals in many parts of the world and a causal agent of tinea and onychomycosis (Frey et al., 1979).

Arthroderma cuniculi was recovered from 2 samples of school playgrounds (out of 25) and had RIV of 9.6. Abdel-Hafez et al. (1989a) encountered the above keratinophilic species in 6% of the soil samples collected from Sinai Governorate (Egypt).

The most common moulds other than dermatophytes and related (keratinophilic) fungi were *Acremonium* (2 species in school playground and house dust), *Aspergillus* (5 species + 1 variety), *Fusarium* (3 species), *Penicillium* (3 species), *Scopulariopsis* (1 species) and sterile mycelium. Although the method used in this research (human hair baits) does not allow to perform a quantitative analysis, it permits to detect their presence. Their presence fluctuated between 12-44% and 8-40% of the playground and dust samples contributing 2.7-20.1% and 3.8-25.8% of total isolates and RIV's of 14.7-64.1 and 11.8-65.8, respectively. The most common saprobic species on the two environments were *Acremonium strictum* (RIV 9.6 and 20.5), *Aspergillus flavus* (RIV 34.5 and 34.6), *A. flavus* var. *columnaris* (RIV 18.7 and 18.1), *A. fumigatus* (RIV 40.2 and 35.6), *Fusarium solani* (RIV 15.3 and 19.8), *Penicillium chrysogenum* (RIV 16.3 and 20.5), *P. funiculosum* (RIV 24.9 and 9.5), *Scopulariopsis brevicaulis* (RIV 24.9 and 20.5) and sterile mycelium (RIV 30 and 11.8). The above species were encountered, but with different numbers and occurrence, from Egyptian and Saudi Arabia air-dust particles on glucose- and cellulose-Czapek's agar plates at 28°C as reported by Abdel-Hafez & Shoreit (1985) and Abdel-Hafez et al. (1986). Most of the previous species were isolated from grain dust from New Orleans (Palgren et al., 1983). Also these species were isolated from soils in many parts of the world using human hair fragments as baits as reported by several workers. The remaining species were less frequent (Table 4).

Numerous fungi were isolated from any of the two substrates: *Chaetomium* (2 species, RIV 15), *Geotrichum* (1 species, RIV 9.5) and *Trichoderma* (1 species, RIV 4.8) in house dust particles; and *Alternaria* (1 species, RIV 9.1), *Emericella* (1 species and 1 variety, RIV 13.6), *Paecilomyces* (1 species, RIV 9.6), *Scolecobasidium* (1 species, RIV 5.1) and *Trichoderma* (1 species, RIV 4.8) in school playgrounds. These fungi are well known as saprobes on various substrates by numerous researchers.

In conclusion, school playgrounds and house dust particles have been contaminated with numerous fungi which are either well-known human and animal mycotic agents (*Microsporium gypsum*, *Trichophyton mentagrophytes* and *T. terrestre*) or have been isolated from human and animal lesions (*Alternaria alternata*, *Arthroderma cuniculi*, *Aspergillus flavus*, *A. fumigatus*, *A. niger*, *Chrysosporium tropicum*, *Emericella nidulans*, *Fusarium moniliforme*, *F. ox-*

ysporium, *F. solani*, *Geotrichum candidum*, *Penicillium* spp., *Scopulariopsis brevicaulis* and several others) as reported by several researchers (Ainsworth & Austwick, 1959; Carmichael, 1962; Salkin et al., 1975; Collins & Rinaldi, 1977; Frey et al., 1975; Rippon, 1982; Frelief et al., 1985; Mitchell et al., 1987). Also numerous of the above species (as members of *Aspergillus*, *Emer-icella*, *Fusarium* and *Penicillium*) are well-known mycotoxin-producing fungi. Hence precautions must be taken by students and families for avoid contamination.

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